

Form 27 (Small)

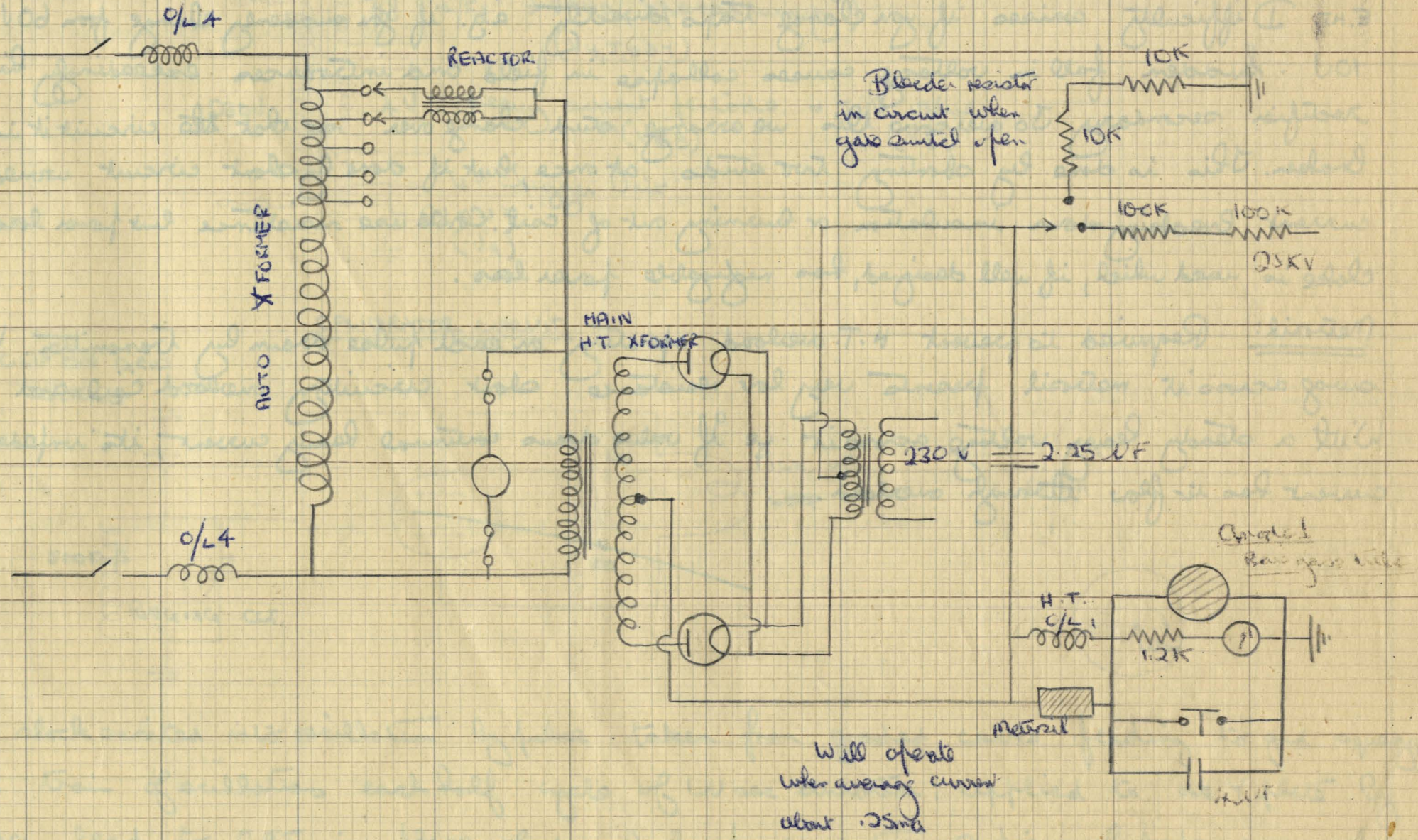
ROYAL AIR FORCE
CHL
SKETCH BOOK

(FOR USE OF THE AIRCRAFT APPRENTICES' TRAINING ESTABLISHMENTS,
THE ROYAL AIR FORCE COLLEGE, AND THE OFFICERS'
ENGINEERING COURSE, HENLOW.)

T. 3079.

CHL EXTRA NOTES

25KV POWER SUPPLY.

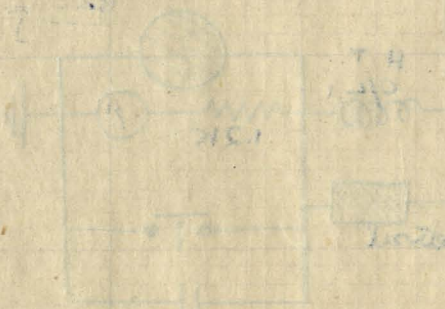


Will operate
when average current
about .25ma

25K1 Power Supply

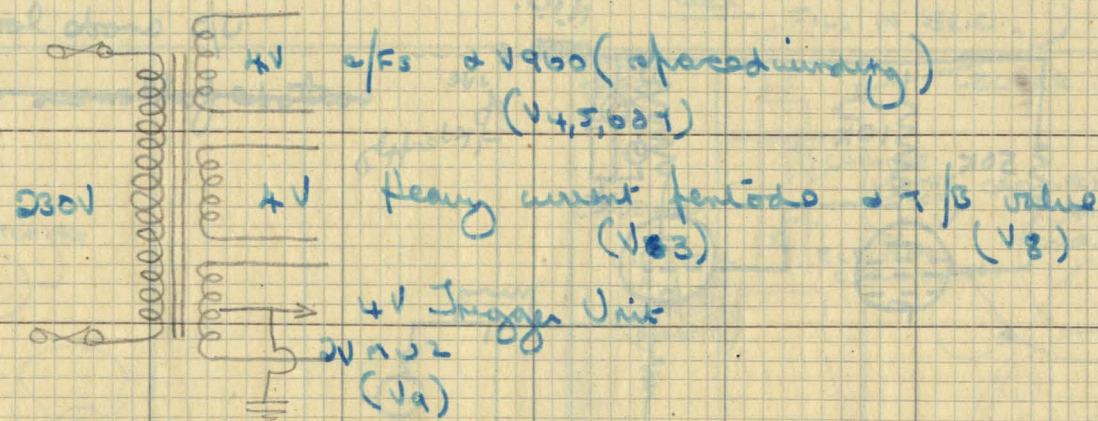
Rector: Auto transformer taps from 60 - 230 volts followed by second step up transformer 230-601-3001 E.H.T. Difficulty arises if you change taps directly e.g. if you suddenly change from 601-0 and then to 101. Sudden fall in voltage causes collapse in field and introduces exceedingly high voltage in rectifier secondary. To overcome this we arrange stud change over so that the circuit it is never completely broken. This is done by shorting two studs at once, but if done by short circuit would create very high current breaking down insulation or burning out of coil. Could use resistance but power losses high so a choke is used which, if well designed, has negligible power loss.

Metroil: Required to prevent H.T. overload operating on each pulse drawn by transmitter. With a sudden surge across it metroil presents very low resistance short circuiting overload coil and preventing operation. With a steady heavy voltage across it i.e. if valve draws continual heavy current, its impedance is high and current has to flow through overload.

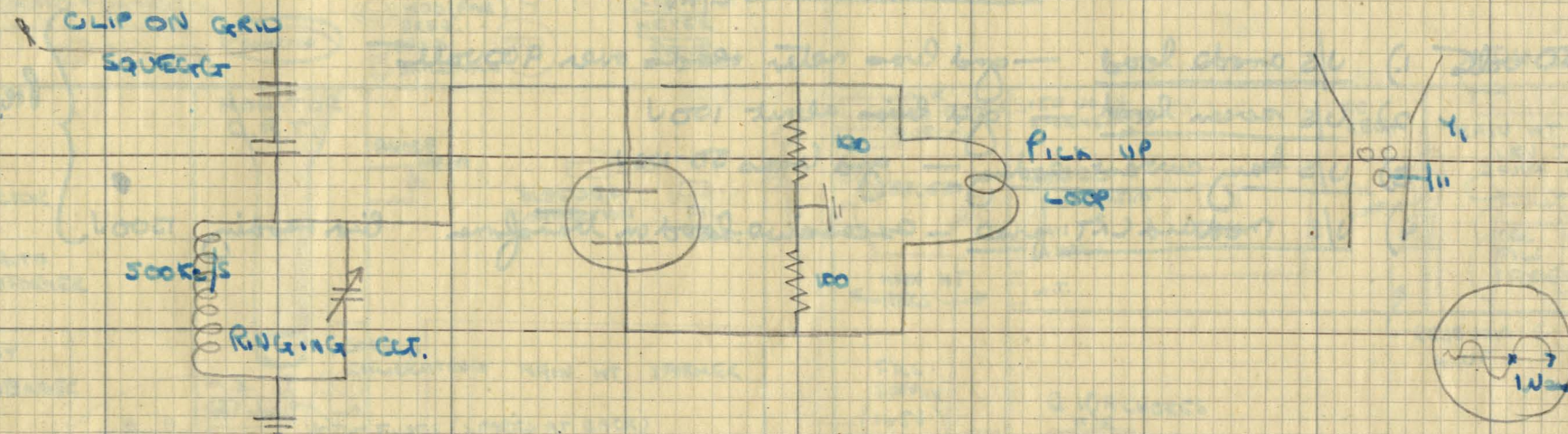


choke coil
resistor
25K1

MODULATOR TRANSFORMER



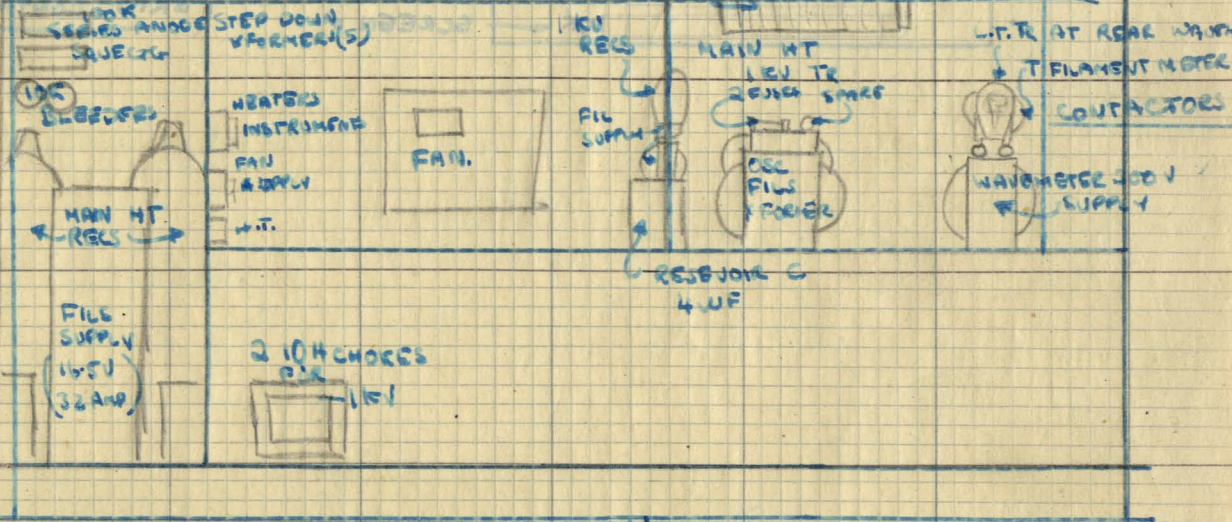
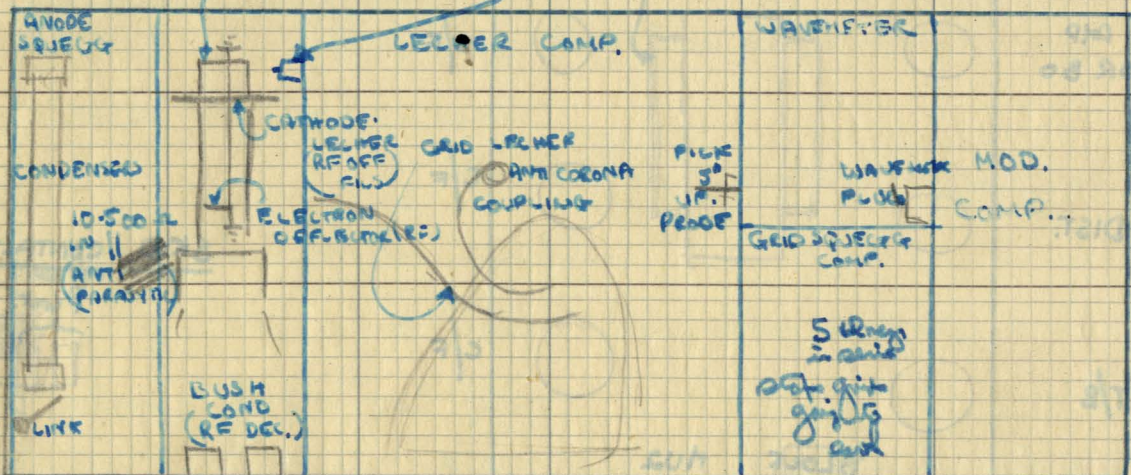
CALIBRATOR CIRCUIT



500KHz ckt. shock excited into oscillation by pulse taken from graded cable feeding to grid squench. Gives damped train of oscillations each half cycle of 1W sec duration. Applied to one Y plate by connecting wander lead to CRT in place of normal loop connection. A piece of paper can now be calibrated.

70019-1070-0000

100-
BISHOP (RF)
FILE IN SERIES



PLUGS

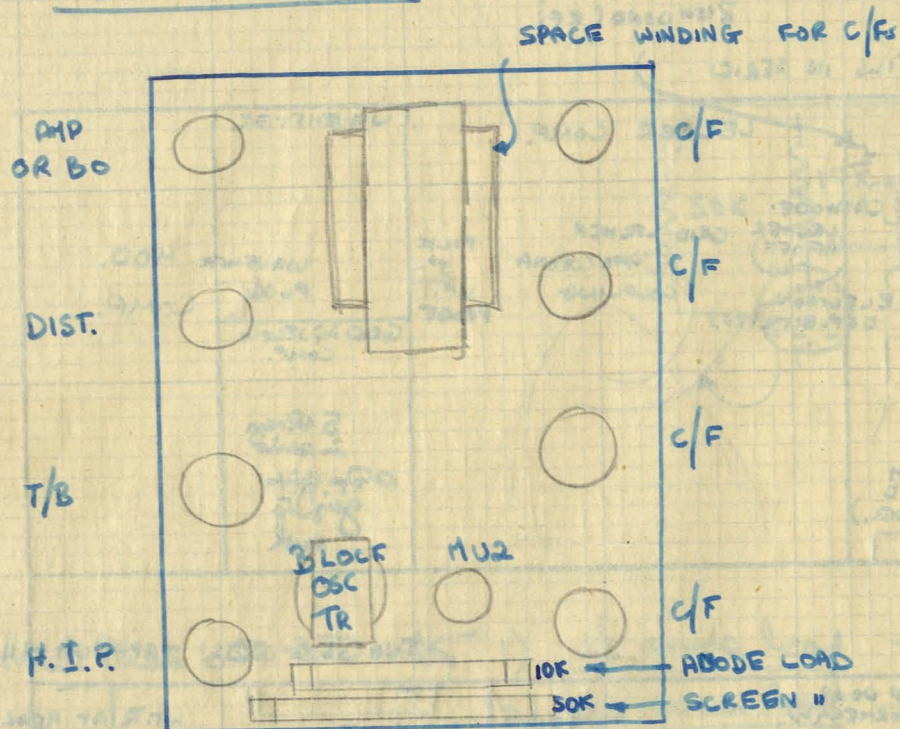
1. BRILL & FOCUS
2. MAIN IN &
300V OUT TO MOD. UNIT.
3. 2.5KV SUPPLY TO MON.
& 4V TO FIL. HEATERS.

1) metas — across supply
 2) EHT — 2ndy auto x former
 3) Filo — 2ndy filo x form
 4) Grid bias — ~~2ndy auto x former~~ grid range (100)
 5) anode I — mode VLT
 6) out II — card = -1.2V (anode C/1)

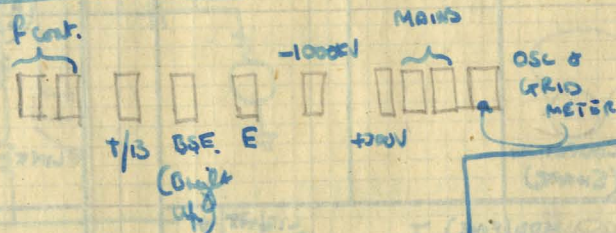
CANARA
 FLWR
 EAT
 LOCK

c) Vervetids - after T02 + GBNV

MODULATOR LAYOUT



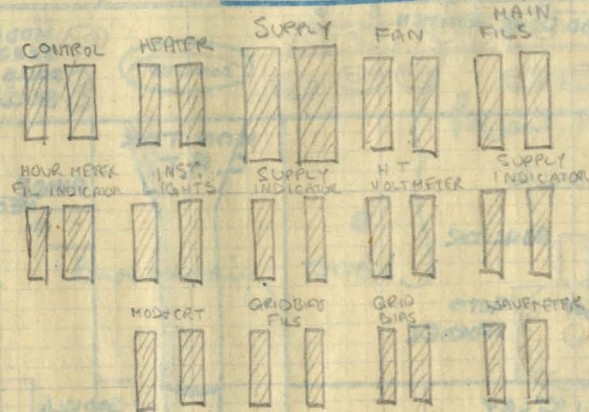
SKID CONTACTS BACK



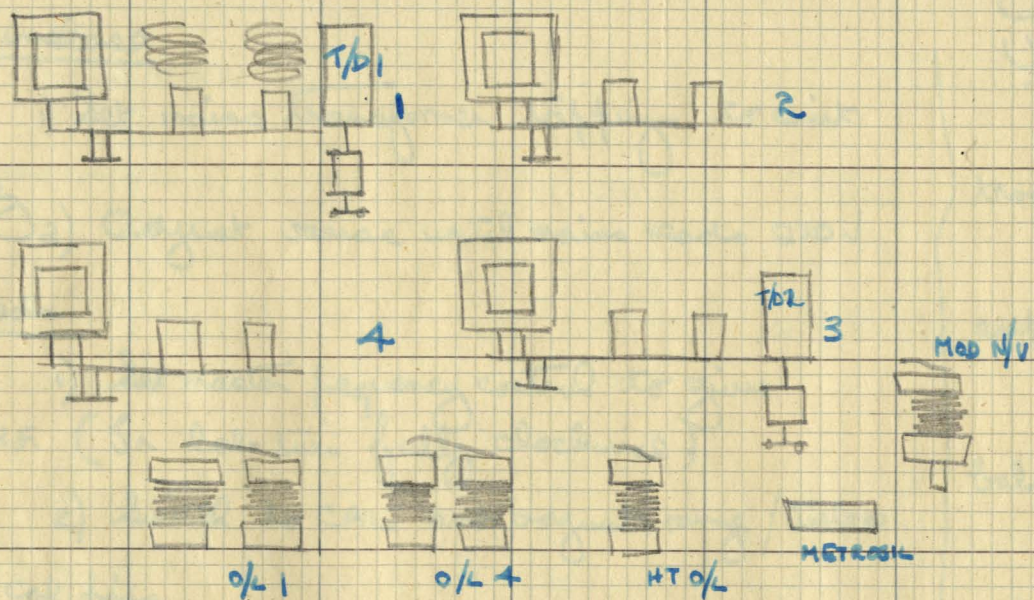
SKID CONTACTS SIDE

- 850V PULSE
- SUPPLY VARIO

FUSE LAYOUT



CONTRACTOR LAYOUT



R 3202 Setting up Procedure.

H/R Limbass

General 1) Set mains transformer tapping to suit local supply.
2) Adjust variac until mains reads 230 V

Horizontal deflection

1) Set master frequency control to give required P.R.F. (3x lab. turn fully clockwise).
2) Switch to CAL and adjust range / time base control for 1st cal. pip.

control for 1st cal. pip.

3) Switch off and remove top cap of second

P.P.A.

4) Switch on set and adjust velocity for trace length of 3"

trace length of 3"

5) Switch off and replace top cap.

6) " on and adjust horiz. balance control for trace length of 6"

control for trace length of 6"

7) Linearity trace with lining and velocity controls.

Vertical deflection

1) Adjust vertical shift control until trace reaches D.C. level.

2) Remove beam lead and adjust cal. amp control for 1st cal. pip.

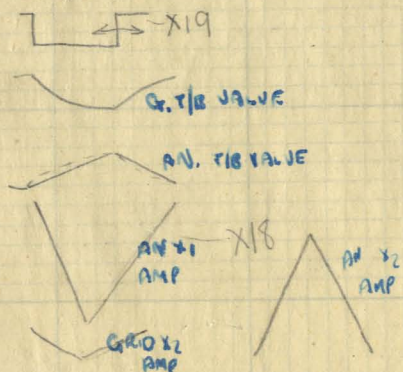
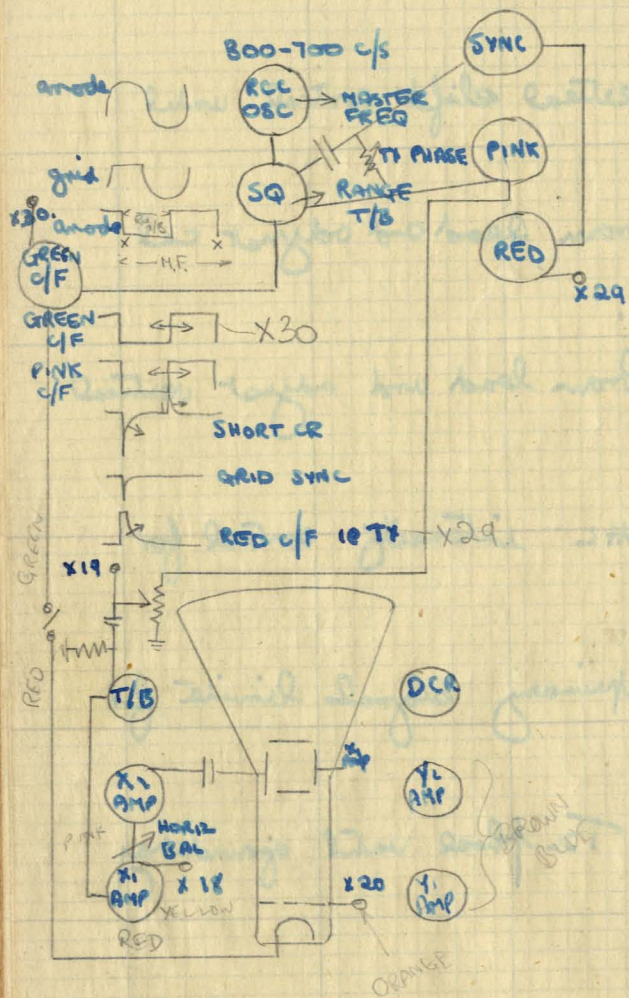
3) Replace beam lead and adjust vertical balance for 2nd cal. pip.

4) Adjust CRT intensity control for operator convenience.

5) Adjust primary signal limiter for 1cm of ground ray.

6) Adjust T₂ phase until ground ray on 3rd cal. pip.

BLOCK DIAGRAM R8202



LAYOUT

RECEIVER

RECEIVER TUNING

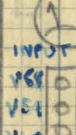


CAL. PHASE & AM (TOP CAP GRIDS) P.P.I. L.M.

PINK
OFF
VCL



MAIN



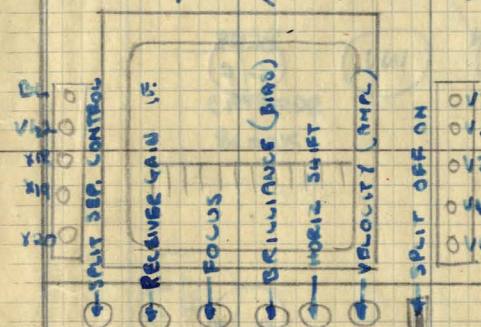
CONTROL
UNIT

VALUE
METER

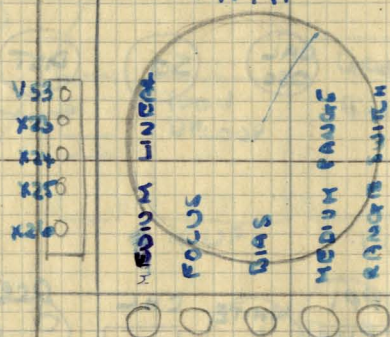


Tx PHASE

H/R (TOP CAP ANODES)

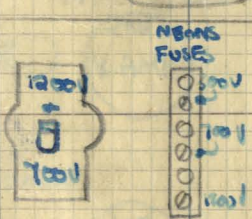


P.P.I.



ALIGNER

MAIN



300V (FUSED)
RECEIVER
SCREEN SUPPLY TAP
T/6 VALVE
CAL. PHASE P.P.I.

2 300V (FUSED)
CONTROL UNIT
FOCUS COIL
P.P.I. T/6 CHAIN



VARIES



P.P.I.

POWER UNIT



Scope points

X.23.



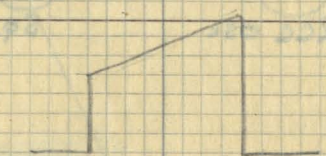
CATHODE FLIP FLOP
(P.P.I.)

X.24.



"BRIGHT UP" CATHODE
YELLOW C/F (P.P.I.)

X.25

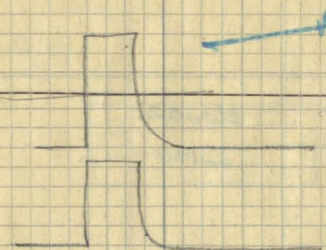


'PREDIAL' ANODES OF
T/6 GEN (P.P.I.)

X.26

CAL OR FIGS ON C.R.T. GRID. (P.P.I.)

X.12.



PINK INPUT ~~TO CALL~~
"USUAL" (H/R)
PINK INPUT AFTER 'VEL'
(H/R)

BLOCKS
OF
CALC

{X.13} DRAW
{X.14} CALC

X.19.

X.18



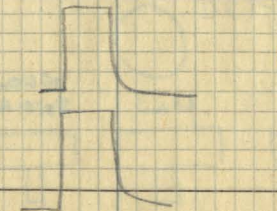
F/D ANODE OF
1ST PARA AMP.

X.20

SIGS OR CALS

CRT GRID (H/R)

X.29



RED PULSE CATHODE C/F
(H/R)
GREEN PULSE GREEN C/F
(H/R)

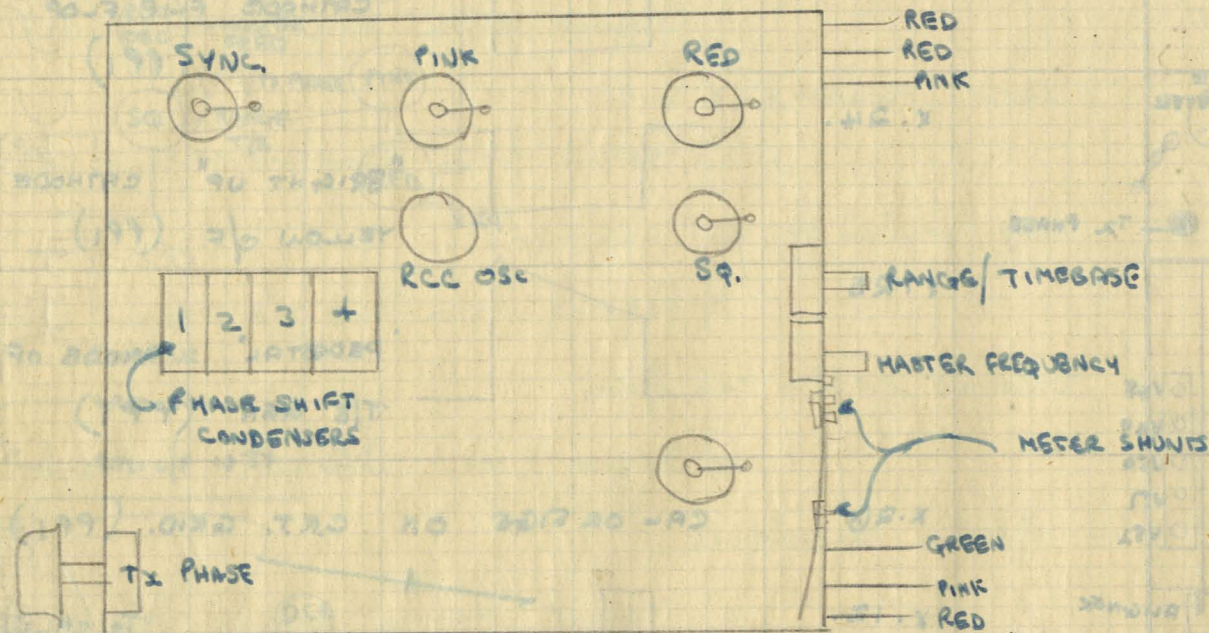
X.30

200V: X AMPS

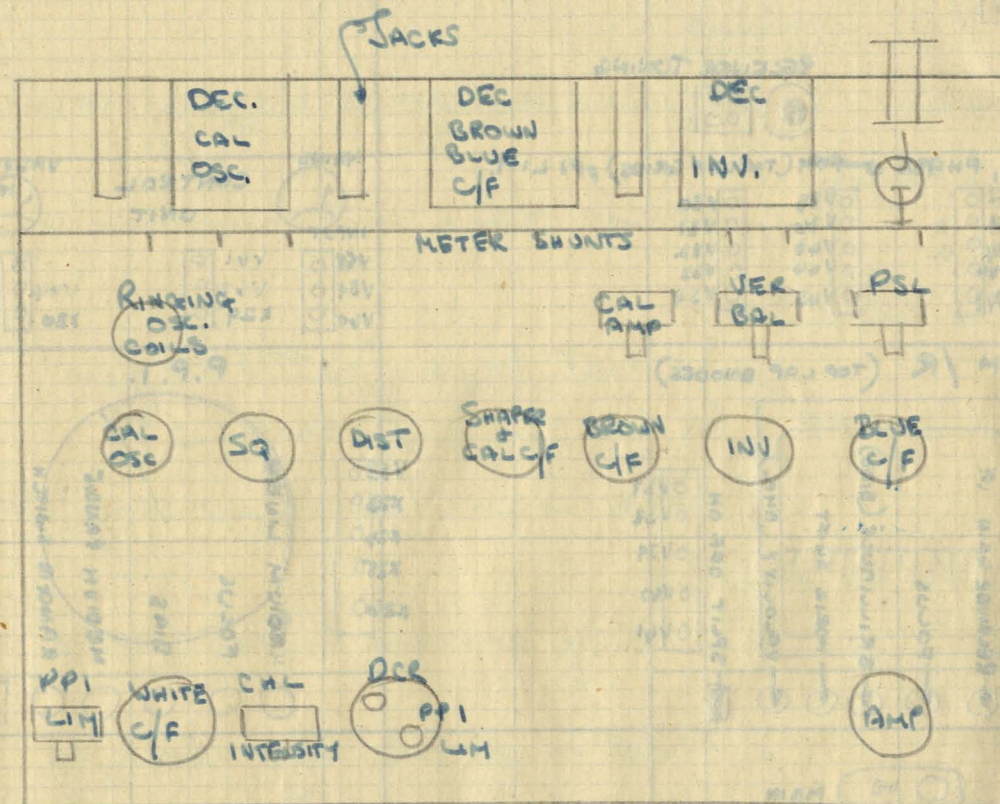
100V:

50V for
RELAYS

CONTROL UNIT LAYOUT



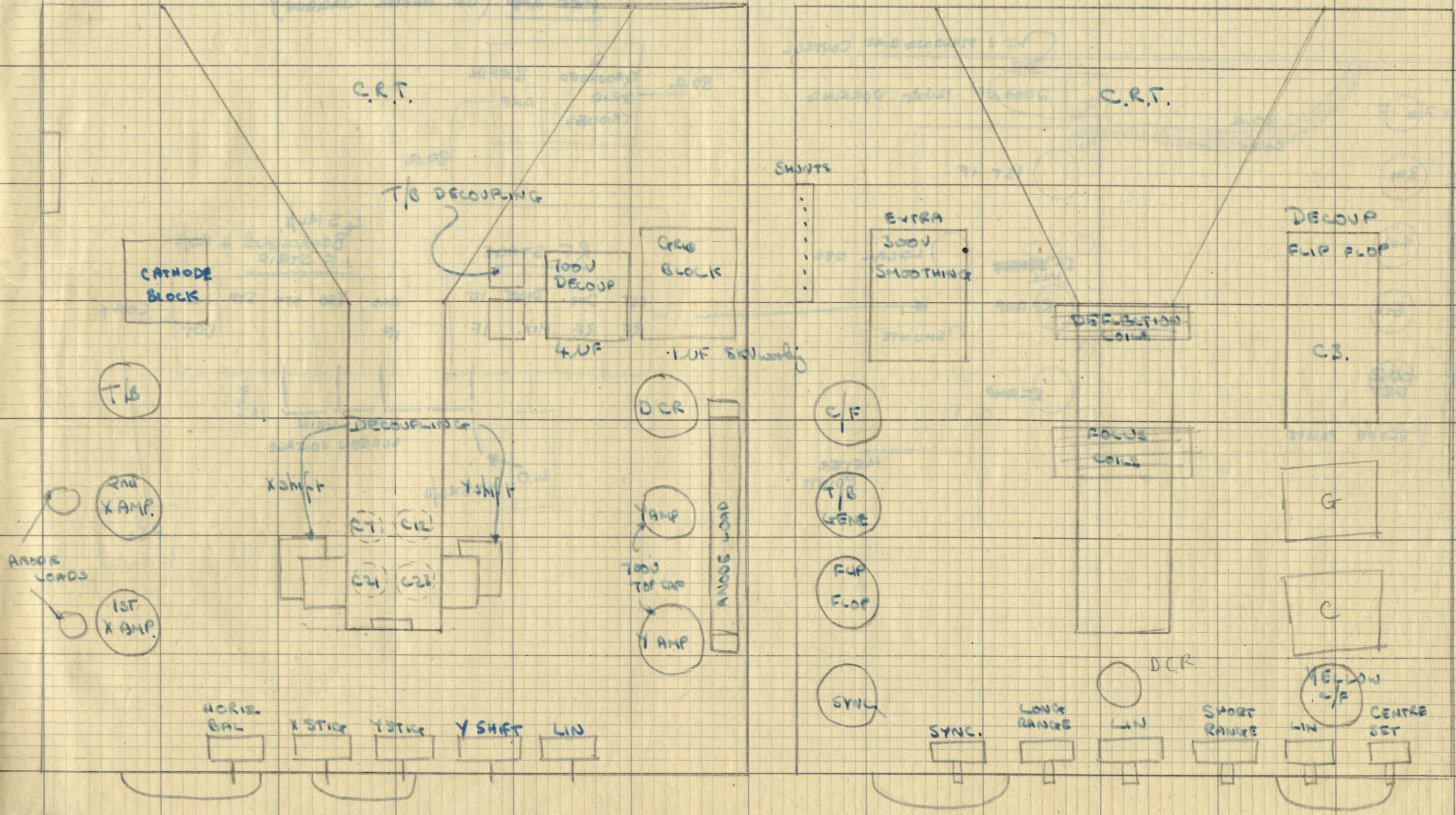
PHASING UNIT LAYOUT



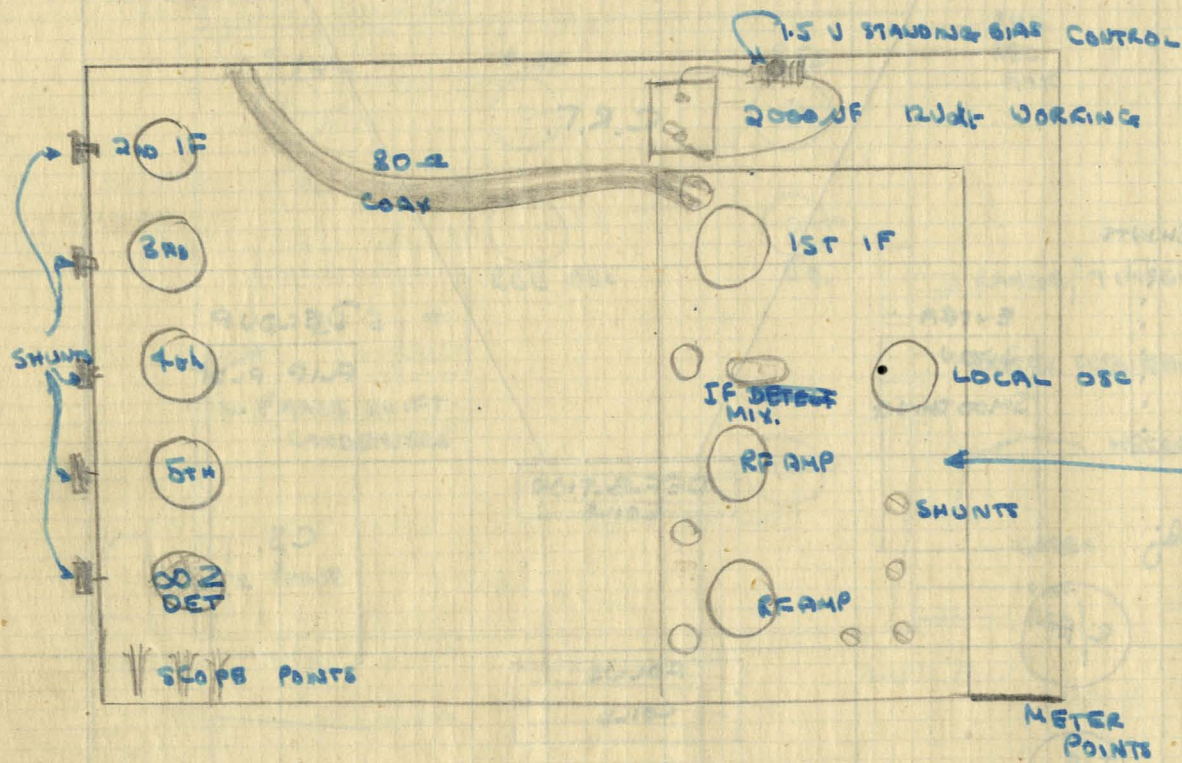
TIMEBASE LAYOUTS

H/R TIMEBASE

P.P.I. LAYOUT

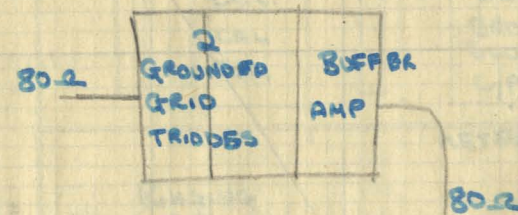


RECEIVER LAYOUT



BLOCK DIAGRAM

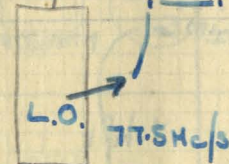
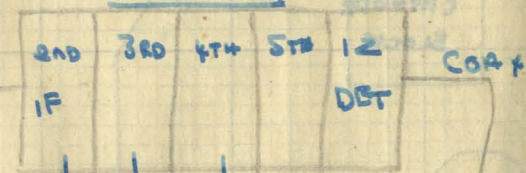
PRF AMP (ON AERIAL WAGON)



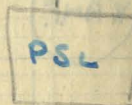
RF STAGE



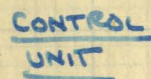
4.5 Mc/s. Bandwidth 4 Mc/s IF STRIP



MAIN GAIN
SCREEN VOLTAGE



5TH TURNING GEAR T.3.



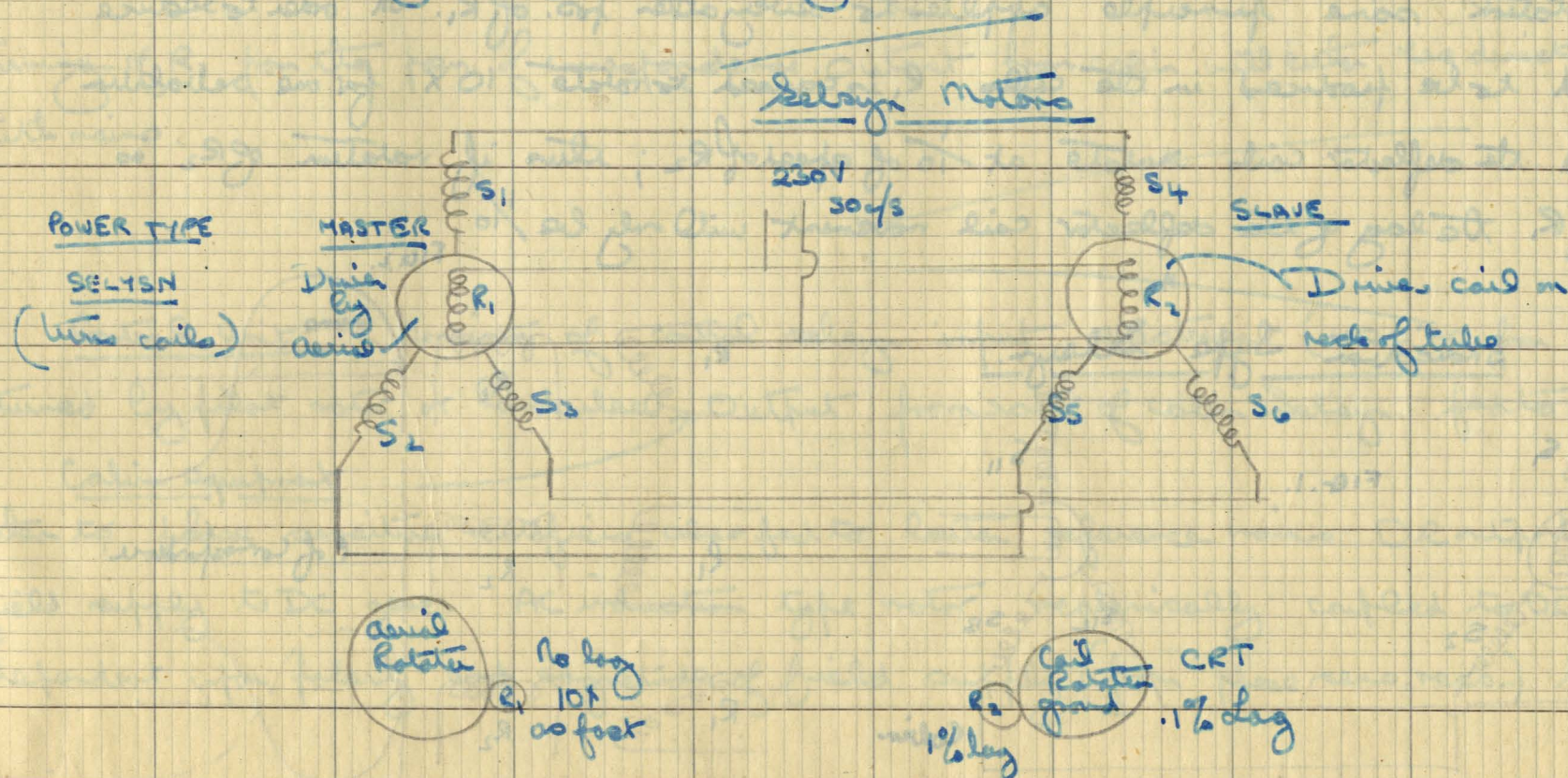
CAGN EQUIPMENT

C.H.L.

B.T.H. Tuning Gear Type 3

Requirements

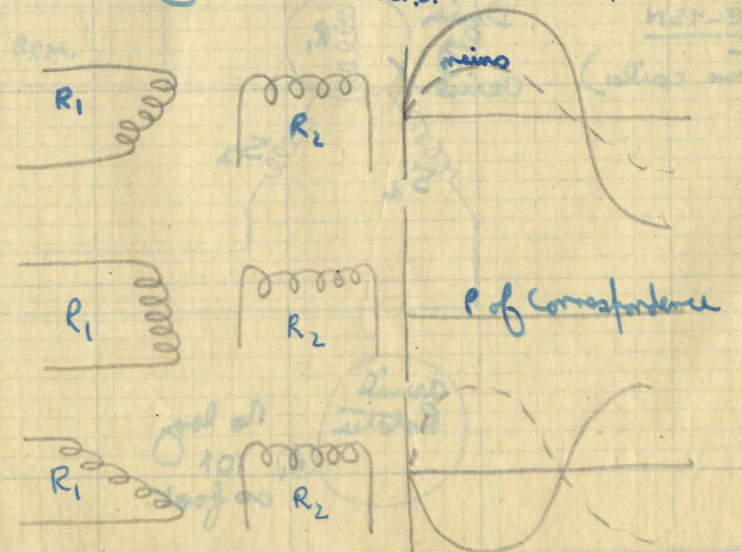
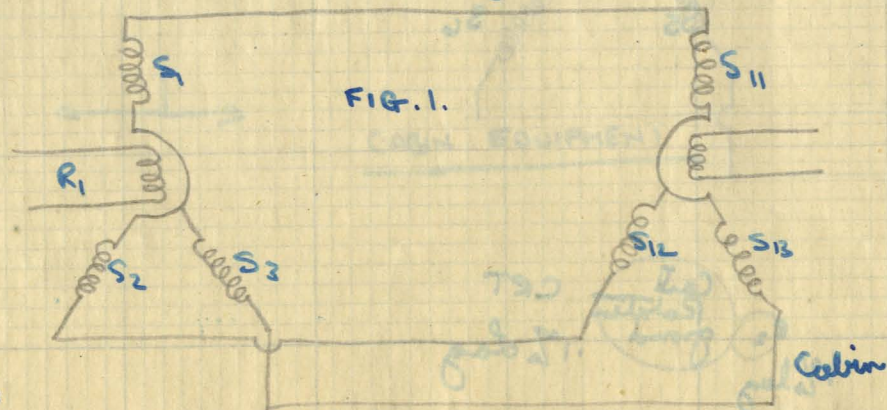
- 1) Continuous rotation either direction of 1 to 6 R.P.M. — done by Ward Leonard system.
- 2) Provision for Remote control i.e. from control unit to aerial — Done by servo relays.
- 3) Stroke indication of a sector on P.P.I. — Done by special commutator.
- 4) Facilities for P.P.I. indication of aerial position — done by power relays.
- 5) Control of two aerial coils for no point.
- 6) Automatic holding to any fixed bearing.



Power Type Delays output Mechanical

When a PPI is used for determination of bearing the scan (trace) must be aligned with the rotation of the aerial. When a magnetic tube is used this can be achieved by moving the deflector coils round the neck of the tube. Mechanical means of obtaining this motion from the aerial rotation are impracticable. Therefore an electrical method known as the delay motor is used. Assume 230V applied to R_1 & R_2 and R_1 being rotated by the aerial system is in a vertical position. Maximum EMF induced into S_1 and max. EMF in the slave system across S_4 . Since R_2 is an electro magnet it will be pulled into line with S_4 , thus slave is always aligned with master and as coils on neck of CRT are driven in synchronism with aerial rotation same principle applies to every other pos. of R_1 . In order to reduce the slight lag which is bound to be produced in the coils R_1 is caused to rotate $10\times$ for one revolution of the aerial, at the other end the deflector coils rotate at $1/10$ of speed of R_2 ; thus if rotation of R_2 is lagging by $1/10$ or rotation of R_1 the lag of the deflector coil movement will only be $1/10$.

Induction Type Delays.

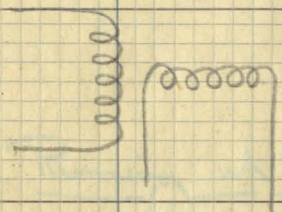


Control Slide

Servo or Indication Type Delay output Electrical



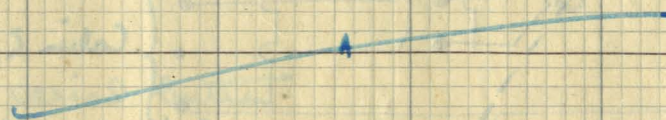
Prim. of correspondence



retroactive prim.

Fig 1 If we pass an AC current through R_1 , EMF will be induced into S_1, S_2, S_3 and current will be established in S_{11}, S_{12} and S_{13} . Thus the field set up by R_1 will be reproduced in the calin delay. R_2 is a search coil and according to its prim. will react to prim. of R_1 will pick up voltage which after amplification and rectification are used to control the turning motor.

Fig 2 Shows how the output of R_2 will vary with direction of the turning of R_1 from the prim. of correspondence. Output from calin will either be directly in phase or 180° out of phase with mains.

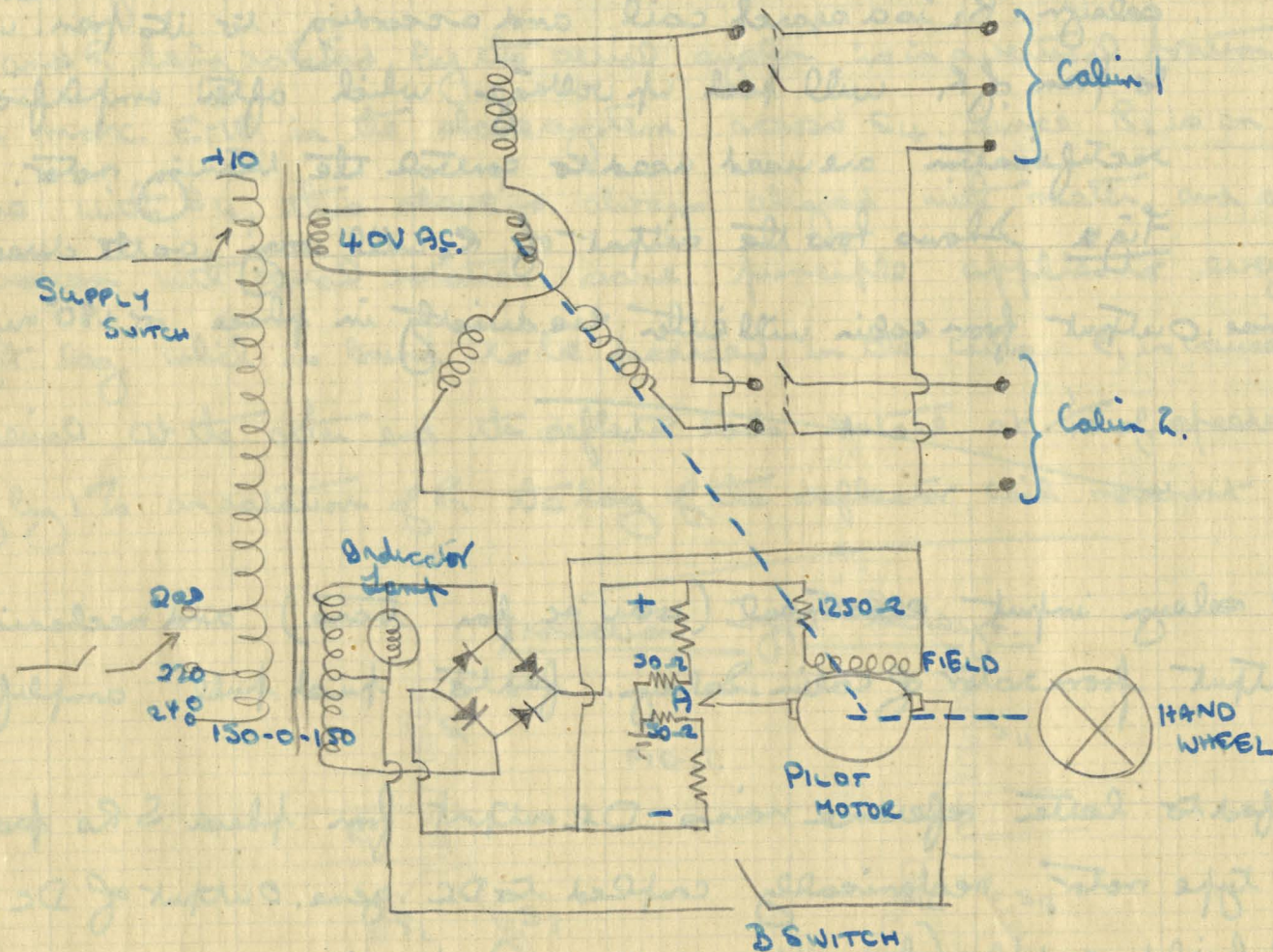


Control Unit consists of control relay input electrical (40V AC for trans.) and mechanical (rotor turned by pilot motor or hand wheel). Output from rotor of calin delay. fed to push pull amplifier and

Calin equipment then to phase sensitive rectifier also fed to latter reference mains. DC output from these S Rs provides field supply to DC gene. AC induction type motor mechanically coupled to DC gene. Output of DC gene dependant upon polarity and magnitude of field supply (from phase sens. recs.) provides accurate current for

"Work" motor. Work motor has permanent field supply hence speed and direction of rotation governed by armature supply. "Work" motor turns aerial P.P.I. relay and calibrator into posn. of correspondence. Contactor unit safety device enabling mechanic to leave aerial calibrator before rotation possible,

Control Unit



Control Unit Contains a relay which is used to control position of cabin. The Rotor supplies ~~the~~ with 40 volts 50 c/s rotated either manually by hand or automatically by pilot motor. Powered motor small DC machine, obtains field and armature supply from rectifier. Armature current variable in direction and magnitude by 'A' control. 50 Ω resistors ensure aerial commences turning at a $\frac{1}{2}$ R.P.M. Automatic turning and hand wheel control interlocked when hand wheel control engaged. Baudot open circuits.

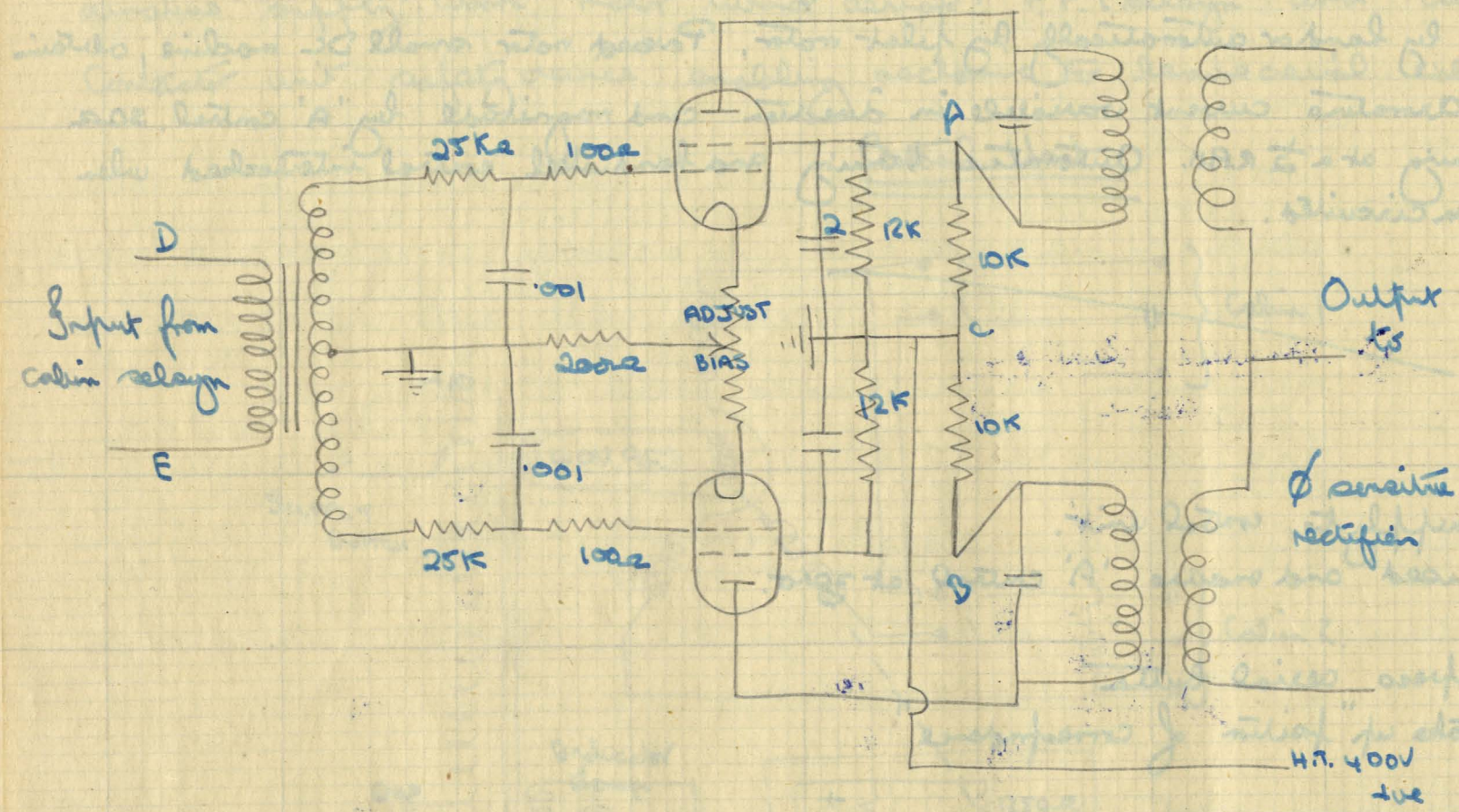
Running up procedure

- 1) Switch on mains supply to control unit.
- 2) Select cabin to be used and ensure 'A' control at zero.
- 3) Start up A.C. motor.
- 4) Close cabin door and press aerial button.
- 5) Wait for cabin to take up "position of correspondence".
- 6) ~~Turn~~

Running down Procedure

- 1) Turn A control to zero
- 2) Trip A.C. motor
- 3) Switch off control unit

PUSH PULL AMPLIFIER



makeup for input

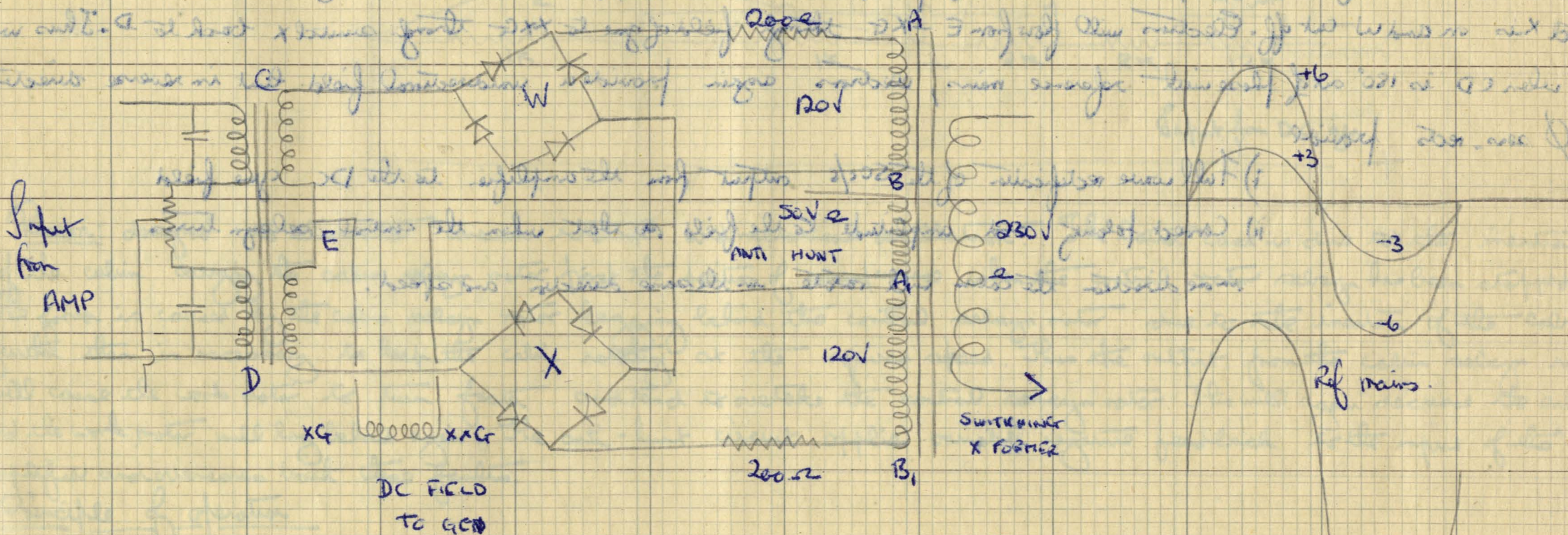
makeup for input

- (1) Input to A and B
- (2) Input to A and B
- (3) Input to A and B
- (4) Input to A and B
- (5) Input to A and B
- (6) Input to A and B

Amplifier

Purpose: to drive into field input the 200Ω resistor. Since the input for the rectifier is alternating at 50 c/sec the amp. has been specially designed to give maximum efficiency at this frequency, other higher frequencies may be picked up in the circuit. Lines that are patterned only field input circuit. Bias is adjustable, so that balance may be obtained indicated when zero potential difference between A & B. (3 volts across each resistor) 200Ω resistor across safe line applied to values

Sensitive Rectifiers



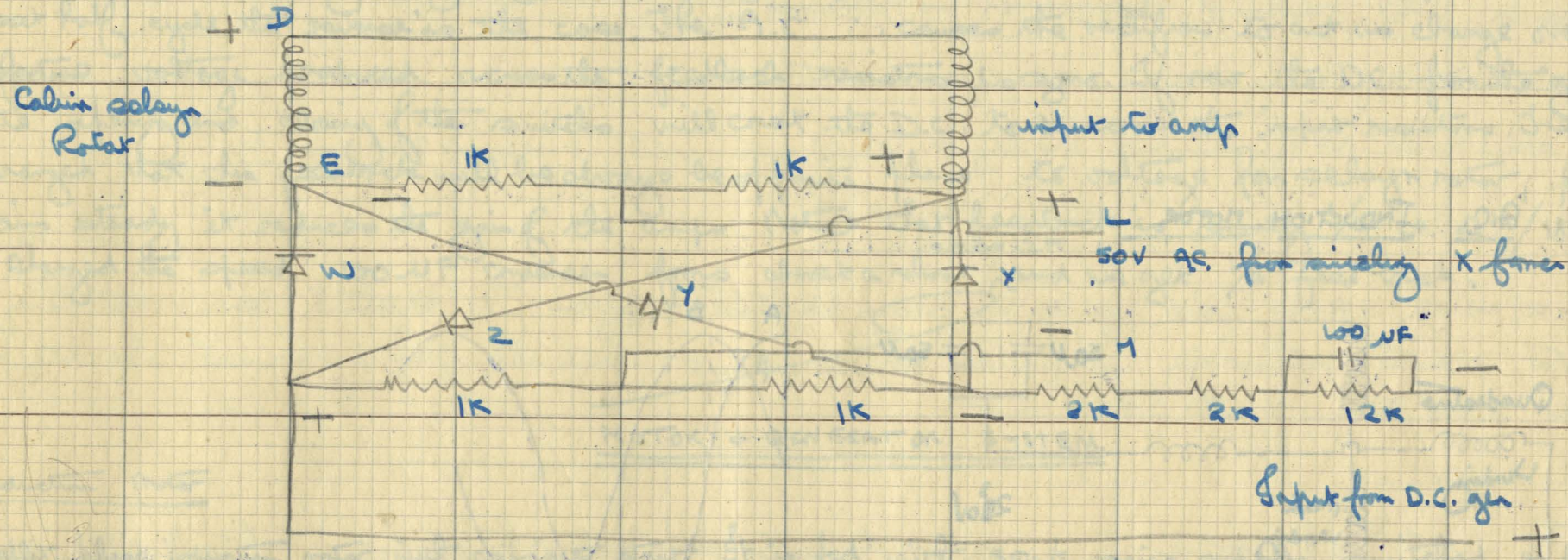
Panor CSD can be considered as a pair of switching contacts and the circuit through them made and broken by application of a suitable potential across A-B, providing that the latter is always in excess of the voltage to be switched across C-D. Voltage across ED in phase with the voltage across AB, A₁B₁. When A is positive with respect to B, switch X cut-on and W cut-off. C positive with respect to D : electrons flow from D through switch X to XXG, through field of gene to X ~~generator~~ and back to E. On the next half cycle A will be -ve and B, positive, and C will be negative D positive.

Switch W cut on and switch X cut off... electrons will flow from C through switch W to XXG through field of gene to XG and back to E. Thus as long as CD is in phase with AB and A, B, electrons will flow from XXG to XG providing DC. gene. and a uni directional field. However, when CD is out of phase with AB and A, B, with A +ve and B, negative, C -ve and D +ve switch X is on and W cut off. Electrons will flow from E - XG through field of gene to XXG through switch X back to D. Thus we see when CD is 180° out of phase with reference mains, electrons again provide a unidirectional field but in reverse direction.

The ϕ sens. rects provide

- i) Full wave rectification of the 50c/s output from the amplifier to the DC gun field
- ii) Correct polarity and amplitude to the field so that when the control relay turns in one direction the cathode will rotate in the same direction and speed.

ANTI HUNT CIRCUIT

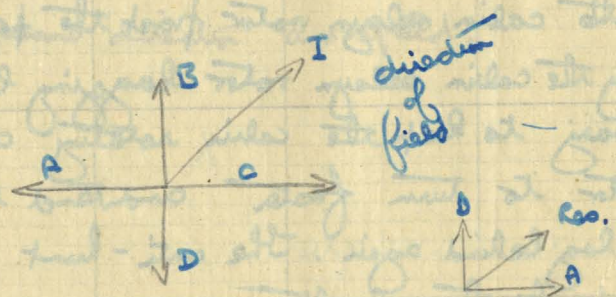
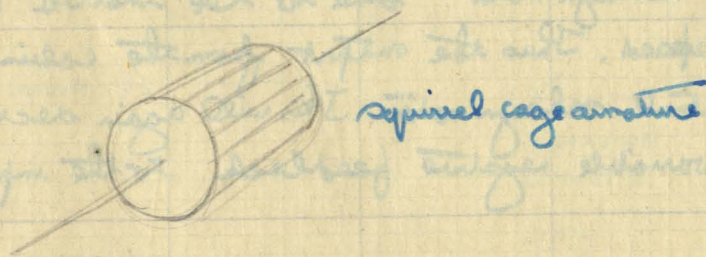
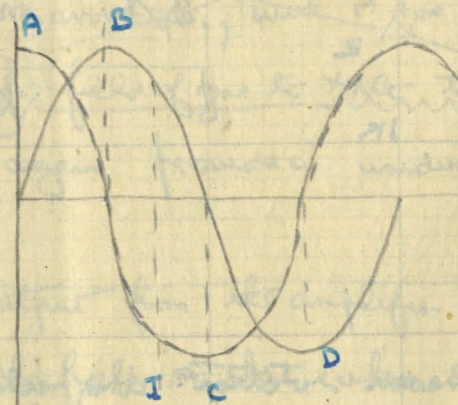
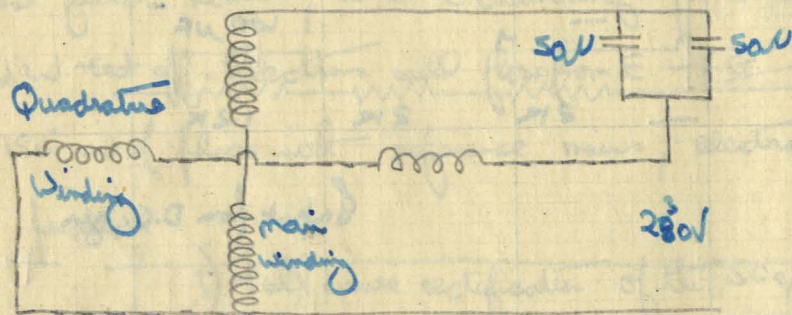


Reason: designed to eliminate uneven rotation and mechanical oscillation. The latter case is due to the inertia of the cabin carrying the cabin selector motor past the position of correspondence when the control rotor selector has been stopped. The former is caused by the cabin selector rotor lagging behind the control selector motor due to the inertia of the cabin. Further than is necessary to keep the cabin rotating at the required speed. Thus the output from the cabin selector rotor will cause the work motor to turn faster and tend to overtake the control selector rotor. This will again decrease the output and the work motor will lag behind again. The anti-hunt circuit applies variable negative feedback to the input of the amplifier and overcomes both these faults.

Principle of operation

The small rectifiers situated in the amplifier are used to convert a D.C. voltage picked up from the gen. armature

A.C. INDUCTION MOTOR



Principle of operation

into A.C. which is used to damp out natural oscillations of the circuit and to make recovery from a change of speed approximately aperiodic. During $\frac{1}{2}$ cycle of A.C. 1 pr. of rectifier is conducting and the other pair is open circuit. On the next half cycle the reverse is the case. The A.C. ... causes the rectifier to act as change over switches, but the effective voltage produced across the feedback resistors is zero. If now the D.C. from the generator is applied the alternate opening and closing of the switches will convert the D.C. to A.C. across the input resistors. The frequency is so averaged that this feedback will be always in opposite phase to voltage from relay motor, providing the D.C. remains steady it reduces the gain of the amp. Notice that feedback is normally $\frac{1}{4}$ i.e. $2K/18K$, If however we suddenly changed the speed 100 μF condenser from almost a short ^{value 12K} and we get $\frac{1}{2}$ feedback.

MOTOR & GENERATOR SYSTEM.

A.C. Induction Motor

This is a split phase induction motor with capacity start. It is fed with 50 c/s mains supply switched on by starter unit. It remains at constant running speed whenever the valve is switched on and drives the armature of the D.C. generator.

Action:— condenser in series with quadrature winding causes current through it to lead on main winding by 90° . At point A current through main winding zero, current in quadrature winding maximum. Field I in direction of arrow. Similarly for points B, C, D and E. Thus the field rotates 1 complete revolution for each cycle of the A.C. Field rotates at 3,000 r.p.m. (since mains 50 c/s). If a shorted coil is placed in the field it has an E.M.F. induced into it and will rotate and try to catch up with the main field (squirrel cage type conductors). Note the speed of conductors cannot be the same as speed of the field, otherwise no E.M.F. induced in conductors and speed will fall off. Good efficiency to get within 50-150 r.p.m. Two condensers chain are in || i.e. 100 μF for starting to overcome the inerts of the motor, switched in series 25 μF for running by the start run switch which also makes the A.C. supply to motor.

Slipping Chisel

Adjustment

- 1) Run gear up until position of correspondence is obtained
- 2) Connect meter capable of reading 30 amps across fuse connections
- 3) Take aerial handle out of correspondence and adjust chisel nuts until it dips at 26.7 amps.

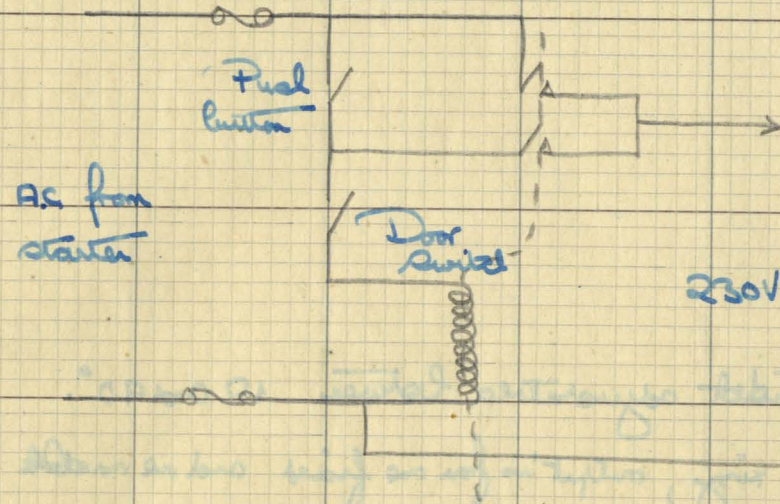
D.C. Generator

This has a separately excited field fed by the phase sensitive rectifier. The armature, being mechanically coupled to the A.C. motor rotates continuously it provides no D.C. output until the field is energized. The output of this gene depends on the output of the field current.

Main turning motor:

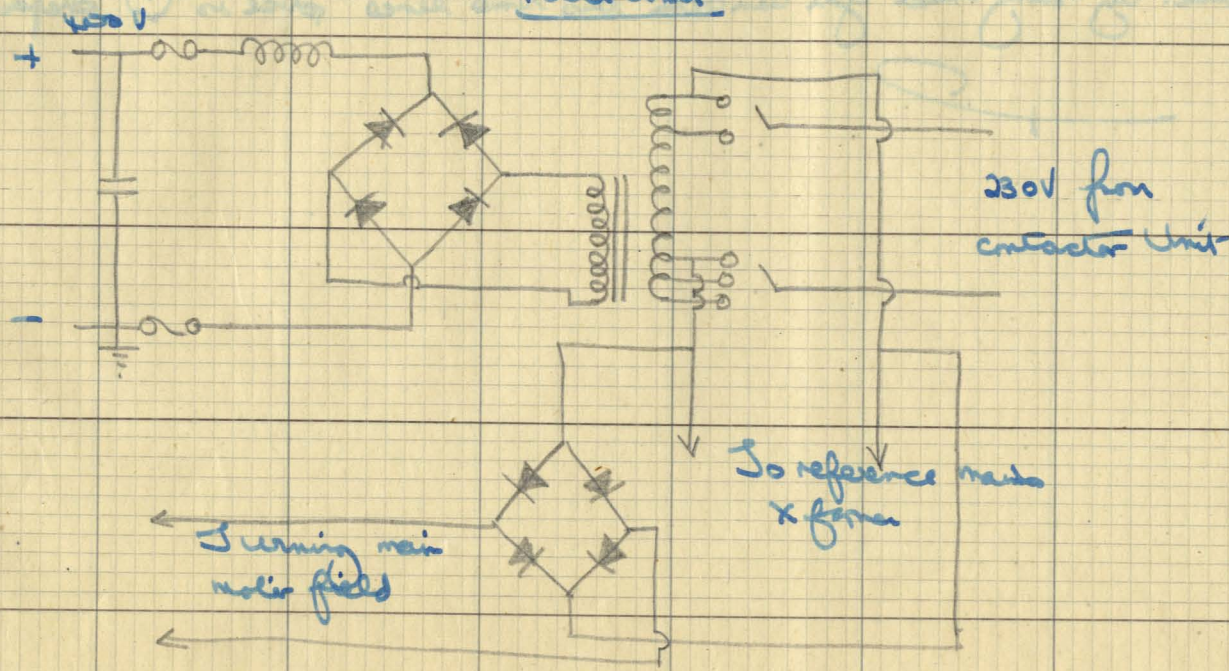
This is a D.C. motor fed from the D.C. gene output. It turns the calin and calin relay. Its field is separately excited which is continuously supplied so that the direction of rotation depends upon the polarity of the armature input.

Contactor Cct.

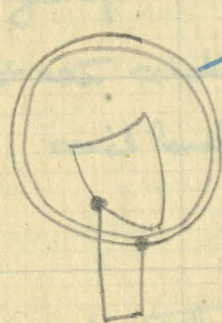


Power unit Xformer
Reference mains
L.T. Xformer.

Power unit



Stroke Commutator



one brush permanently made

making

after brush only makes
contact when touching disc
which is rotating at aerial speed.

This enables an indication of any desired sector to be seen width adjustable between 10 and 90° .

Disc rotates at aerial speed two brushes feed D.C. to two conducting ring, output is for one fixed and one movable brush. N.B. Output only when brush touches disc. by moving brush you can alter this time since disc is $\heartsuit$ shaped

